Full-scale experimental studies of the performance of typical civilian mail room construction subject to small detonations.

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BACKGROUND

Over the past few years there has been a measurable increase in the number of incendiary devices, explosive devices and dangerous articles that have been sent through the postal/delivery systems by terrorist, political and criminal groups. This increase in the number of devices sent, together with an apparent improvement in the sender's ability to disguise the devices (e.g. through the use of video cassette boxes, postal tubes, jiffy bags etc.) has made detection by simple visual examination very much less reliable.The scale of this form of threat is a relatively modern development and many companies previously considered to be at low or negligible risk now need to look at their security systems. Much of the stock of office accommodation has not been designed with this particular hazard in mind and it is reasonable to surmise that retro-fitting of mail room areas will often be deemed to be appropriate. The cost of dealing with this perceived risk clearly could add to the overheads of company or institution involved. This financial consideration together with the need to protect staff from injury and business from interruption requires that investment in security systems should achieve the required protection at an acceptable price. The detection rate of small devices can be improved by the use of X-ray scanners, but these also have a vulnerability and careful planning of a scanner facility should reduce the consequent risk to personnel and to business.

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The aim of this paper is to present plans for a series of explosive trials for the development of a model Mail Screening Facility. The facility will be based on the requirements of medium sized company occupying an eight storey office building. The office building (Figure 1) was constructed specifically for the purpose of conducting a variety of destructive trials representing possible hazards which might occur in realistic environments and has already undergone a series of large scale fire tests. The mail room facility, which is being built using lightweight materials, is designed to minimise the consequences of blast and fragmentation effects on the mail room staff from an explosive device detonating within an X-ray machine.The construction to be tested is suitable for use in new buildings and also existing modern office buildings.The output from this project is to assist in the development of advice for architects and others in the construction industry involved in the specification, design and installation of such facilities.

THE FACILITY

Two mail room facilities, identical in plan, based on one of the UK Government's standard layouts for a continuous screening system, are under construction in the BRE LBTF (Figure 2). The design and arrangement of the room sets have been undertaken by an architect with the brief that the building is required to house the headquarters of a notional law firm with a staff of around 300. Figure 3 shows the location of the scanner room and the scanner operators' area in the context of the primary mail/goods reception room, typical storage rooms and the security staff room. One scanner room will be constructed using a standard manufactured high-duty partition walling system (British Gypsum's Gyproc Security Wall) erected in accordance with the manufacturer's specification. The other will be constructed using similar partition materials, but to an enhanced specification and a different ceiling system, also the raised access floor will be fixed to the supporting pillars. In the first trial, the scanner room will be designed with a double glazed vent .

The location of these two sets of rooms is on the fourth and fifth floors of the eight storey building, adjacent to the rear wall. Of course, mail rooms would not normally be located in such positions, but since the building is founded on a 1.25 metre thick concrete foundation and usually such buildings would have basements and hence flexible floors at ground level, it was felt that simulation of this structural condition was important for the tests. Another criterion to be considered was the surrounding structure for the two facilities, here the need was to ensure similarity and because of the local structural damage which has generated in other test programmes, this objective is best met by choosing the rather high locations.

The external gable walls of the building are 140mm dense concrete blocks which, in the scanner room area, will be lined with heavy duty partition panels, whilst the main flank walls are glazed with proprietary systems installed over a 900mm high concrete block dado. The post room and store rooms are constructed from a proprietary gypsum board system with no strength enhancement. Suspended ceilings with light fittings and hidden forced ventilation ducts will be installed, so also will be the raised access floors which are typical in this class of building. The intention is to create the best replication of real life ,so all the rooms will be appropriately furnished with tables, chairs, cabinets, mail bags and loose mail etc.

THE TRIALS

The principal tests will involve the detonation inside an X-ray scanner machine placed in the Scanner Room (cf. Figure 3). Of particular importance will be the opportunity to observe the performance of the walling systems, especially their capability to contain high velocity fragments created by the devices and the destruction X-ray screening machine itself. There are other characteristics of this hazard which will be studied in the programme notably the accuracy of the predictive tools for pressure and fragment distribution. Many explosion tests have been undertaken in simple environments but the evidence suggest that whilst estimates of pressures which are satisfactory for engineering purposes can be made for such situations, the methodologies are not so powerful for predictions in multiple rooms. One reason for this shortcoming is that the computer codes for dynamic load assessment have not been calibrated against data from such complex spaces. There is little doubt that the high quality data from these tests will be an invaluable aid for the development of practical commercial programs. The industrial partners who are supplying the suspended ceilings and raised floors will be studying the performance of several systems with a view to establishing design requirements for these elements subject to this particular loading.

There are a number of problems to be addressed such as,

Would a strong system act as an ‘internal vent’?

Is it possible to have a massive system which stays in place following significant distortion?

Are very lightweight tiles the safest and most economical solution?

This work will start in a small room constructed on the ground floor and systems of particular interest chosen for installation in the main room sets.

The details of the final programme are yet to be established, but it is envisaged that full instrumentation, recording displacements and time/pressure histories, will be undertaken. It is the intention to use high speed filming and video to record debris paths and distribution and laser systems to monitor structural displacements. One area to be addressed, which is not a direct safety hazard, is dust. Major problems are caused in modern offices by contamination of computer-based systems and air conditioning or ventilating systems. In view of this, part of the assessment of the systems will be related to dust production. Unfortunately this appears to be quite a difficult environment for the use of particle measuring equipment since these are normally designed to operate in less hazardous conditions.
The first trial is scheduled to take place in the second half of October this year.

THE OUTPUTS

The outputs will include data for the calibration of pressure prediction analytical programs, a draft design specification for suspended ceilings prepared under the auspices of the SCIA (The Specialist Ceilings and Tnteriors Association). Data on the performance of glazed venting panels. Most importantly, a demonstration of the performance of the whole system.

REFERENCE

Veale C J R., X-ray screening of mail and delivered items & the Cardington Large Building Test Facility. Proc. Second Cardington Conference. Pub E & F Spon, London, November 1996.

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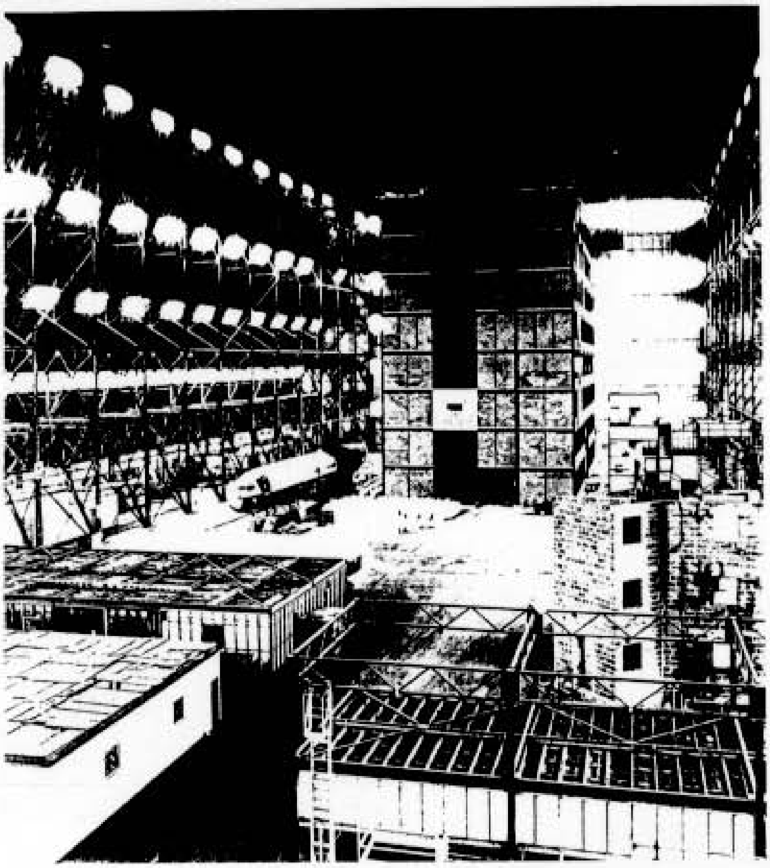

Figure 1 Eight storey steel framed structure in the Large Building Test Facility

Figure 2 Mail room facility during construction.

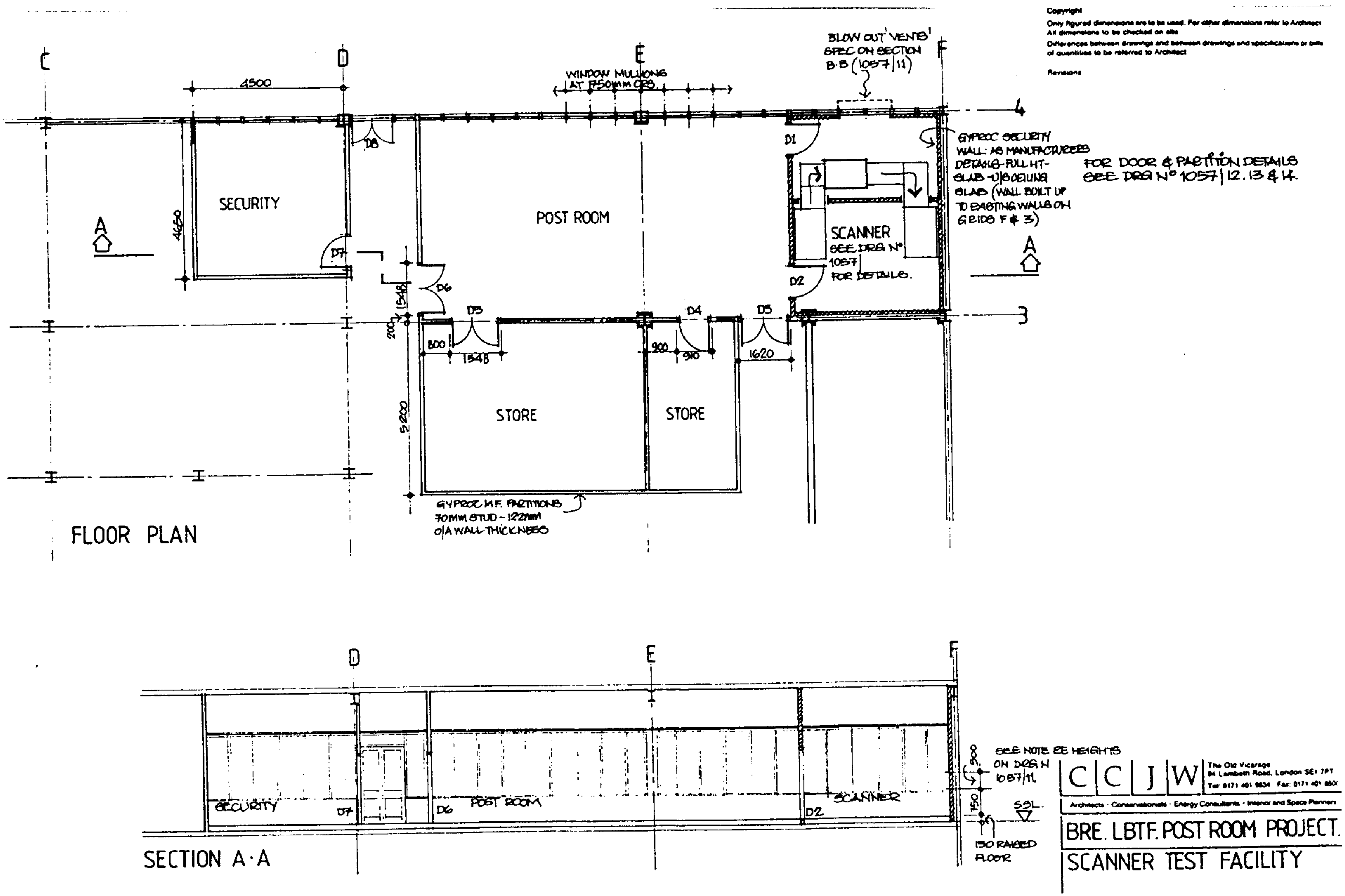

Figure 3 Plan of complete mail room facilities showing location of the scanner room.